Southern Forest Experiment Station

SO-235

Research Note

1978

Performance of Species-Reciprocal Hybrids Between Slash and Shortleaf Pines

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SUMMARY

Hybrids between shortleaf and slash pine were made by controlled pollination with each species used alternatively as the female parent. Hybrids with shortleaf as the female parent survived planting better than those with slash as the female parent. In all other respects—height, d.b.h., and resistance to diseases and insects—the species used as female parent did not affect resulting progeny.

Additional keywords: *Cronartium fusiforme,* interspecific hybridization.

TESTING OF HYBRIDS

On forest sites where risk of fusiform rust (*Cronartium fusiforme* Hedgc. & Hunt ex Cumm.) infection is high, southern pine hybrids may be an alternative to susceptible loblolly (*Pinus taeda* L.) and slash pines (*P. elliottii* var. *elliottii* Engelm.). A recent study has shown the hybrid between shortleaf (*P. echinata* Mill.) and slash pine to be rust resistant and well adapted to certain Upper Coastal Plain and Piedmont sites in Georgia and Alabama (Wells and others 1978). If hybrids are to be planted commercially, they must be efficiently mass-produced and therefore more information about artificial pollination techniques is desirable.

This report describes an experiment designed to test effects of using slash pine and shortleaf pine alternatively as the female parent for the production of hybrids. The main objective was to test the assumption that maternal effects would not be of practical importance in the hybrid. A secondary objective was to test how geographic seed source of the shortleaf parent affected the performance of the hybrid.

MATERIALS AND METHODS

Parent trees in this experiment are slash pines of northern Florida origin growing on the Harrison Experimental Forest in southern Mississippi, and shortleaf pines of various provenance growing in the A. J. Hodges Experimental Area near Many, Louisiana. The slash pines originated from a commercial seed collection and the shortleaf pines from seed collections made for the Southwide Pine Seed Source Study (Wakeley 1961). Pollen from 21 of the slash pines was composited and used on from two to six trees of each of six provenances of shortleaf pine in 1960. Pollen was collected from the shortleaf pines in 1960, stored, and applied to the slash pines in 1961. Sausage-casing isolation bags were used, and standard controlled pollination methods were applied.

Hybrid seed, seed from local shortleaf, and seed from the same slash pines that provided pollen for the study were sown in the spring of 1963 at the Harrison Experimental Forest nursery. Hybrid seed from the slash and shortleaf mother trees were grown in adjacent 90-

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foot-long seedbeds. The area had been used as a pine nursery for many years and was uniform. In addition, both beds received similar culture before sowing and during the growing season. Seedlings were planted in February 1964 on the Harrison Experimental Forest. The site was cutover longleaf (*P. palustris* Mill.) land with infertile, sandy soil; plantation spacing was 8 x 10 feet. A randomized complete block design was used with 10 blocks of five-tree plots and 14 "treatments."

Heights were measured at time of planting, and trees were remeasured and scored for height, survival, and insect and disease attack annually for the first 3 years and at the end of the 5th and 10th years in the field. Diameter at breast height was measured after 10 years. Competition between row plots was becoming severe after 10 years, so the test was ended. Tip moth (*Rhyacionia frustrana* [Comst.]) and fusiform rust were the only serious pests during the 10-year period. Plot means were calculated and used as the units of analysis, and data expressed as percent were transformed to arc sine $\sqrt{\text{proportion}}$.

RESULTS AND DISCUSSION

Immediately after germination, the slash x shortleaf hybrids grew much faster than those with shortleaf as the female parent. This initial growth advantage gradually decreased until the two groups of hybrids in the adjacent seedbeds were about the same size by the end of the growing season. The sample removed for planting showed hybrids with slash as the female parent were about one-tenth of a foot taller. This performance is probably explained by the differences in seed size between the two groups. Slash pine seeds are about three and one-half times as large as shortleaf pine seeds (U.S. Forest Service 1974), and their larger food reserves promote fast early growth.

Differences due to geographic origin of the shortleaf parents were very small in the seedbed. The parent species provided the only discontinuities in the appearance of the seedbeds as slash was taller and shortleaf shorter than the hybrids. Hybrids in both beds took on a typical slash "bronzy" color by midwinter. With one exception (PA), the hybrids did not survive planting or the period between establishment and age 10 as well as either shortleaf or slash pine (table 1). Between 2 and 10 years after planting, about 17 percent of the hybrids died, but only 5 percent each of shortleaf and slash pines died.

The hybrids made with shortleaf as the female parent survived planting better than those made with slash as the female parent. The tendency was statistically significant but inexplicable. As previously noted, the two groups of hybrids did develop in the nursery at different rates and perhaps this put them into slightly different physiological states at lifting time and affected their ability to survive planting.

The hybrid is usually made with shortleaf as the female parent because slash flowers 2-3 months earlier in the spring, thus making possible the use of slash pollen that has been stored for only 2-3 months. Also, the later flowering of shortleaf minimizes the chances of losing female flowers to late freezes. Shortleaf also flowers more profusely than slash. The survival differences found in the present study constitute one more reason for using shortleaf as the female parent.

The survival differences were the only consistent species-reciprocal effect in the study. In all other traits at whatever age—height, d.b.h., and attack by rust, tip moth, scale insects, needlecast, and rodents—the means of the two groups of progeny did not differ. In fact, the three economically important traits measured at 10 years (height, d.b.h., and rust infection) were virtually identical for the two groups (table 1). Hybrids varied considerably in species-reciprocal effect among individual sources of shortleaf, but the variation did not consistently favor either species as the male or female parent. Experimental error was undoubtedly higher in the comparisons of individual hybrids than for the means of all six. Most notable in this regard, the poor survival of hybrids made with northern Mississippi shortleaf as male parent probably biased to some extent the species-reciprocal effect in other traits for that particular hybrid.

Geographic origin of the shortleaf parent provided no recognizable pattern for differences in survival, height, d.b.h., and rust infection. Hybrids made with shortleaf from northwestern Georgia and southeastern Arkansas ranked high in 10-year height and d.b.h. Hybrids made with shortleaf from these same areas also grew well in plantings in another test in northern Alabama and central Louisiana (Wells and others 1978). In the present experiment, slash ranked high in height and d.b.h., and shortleaf ranked below average. Apparently geographic origin, though it has affected growth rate in provenance tests of shortleaf pine (Wells and Wakeley 1970), is not important when choosing shortleaf pine parents for hybrids to be used in the southern

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Table 1.—*Performance of species-reciprocal hybrids between slash and shortleaf pines and parent species when grown in southern Mississippi. Geographic source of the shortleaf parent is designated by compass quadrant (SE =southeast, etc.) and Post Office abbreviations.*

Geographic source of shortleaf parent	Shortleaf (♀) x slash (♂)					Slash (♀) x shortleaf (♂)				
	Survival —Year—		Height	D.b.h.	Rust	Survival —Year—		Height	D.b.h.	Rust
			At 10 years					At 10 years		
	2	10				2	10			
	Percent		*Ft*	*In*	*Percent*	*Percent*		*Ft*	*In*	*Percent*
NW GA	76	70	28.0	5.2	5	68	60	24.8	4.1	8
SW AR	68	44	25.8	4.4	0	74	62	22.7	4.1	4
SE AR	70	60	25.6	4.3	3	58	44	28.5	5.3	0
PA	94	72	23.7	4.3	2	82	62	24.5	4.6	10
N MS	66	48	22.1	4.1	19	14	8	27.5	4.6	0
N AR	78	54	20.8	3.8	13	48	30	19.6	3.5	20
Mean of hybrids	75	58	24.3	4.4	7	57	44	24.6	4.4	7
Slash	90	82	29.4	4.8	36					
Shortleaf	80	78	23.7	4.4	2					

Coastal Plain and Piedmont. So if the shortleaf x slash hybrid is to be used within the range of fusiform rust, its principal area of potential use, outstanding individual shortleaf trees can be used as parents regardless of geographic origin. Farther north, nearer the northern extremities of the shortleaf range, geographic source becomes an important factor in choosing shortleaf parents for the shortleaf x slash hybrid (Wells and others 1978). Geographic source of parents is also important for the pitch pine (*P. rigida* Mill.) x loblolly pine hybrid when it is to be planted in the northeastern United States (Little and Trew 1977).

Thirty-six percent of the slash pines had either a branch or stem infection at 10 years, but only 2 percent of the shortleaf pines were infected. The hybrid most resembled the shortleaf parent in this respect with 7 percent average infection. Clearly, the hybrids possess a very potent form of resistance, a trait that should make them particularly valuable in a breeding program for rust resistance.

LITERATURE CITED

Little, S., and I. F. Trew.
1977. Progress report on testing pitch x loblolly pine hybrids and on providing hybrid seed for mass planting. *In* Proc. 24th Northeast. For. Tree Improv. Conf. p. 14-28.

U.S. Forest Service.
1974. Seeds of woody plants in the United States. U.S. Dep. Agric. For. Serv. Agric. Handbook 450, 883 p.

Wakeley, P. C.
1961. Results of the southwide pine seed source study through 1960-61. *In* Proc. Sixth South. For. Tree Improv. Conf., p. 10-24.

Wells, O. O., and P. C. Wakeley.
1970. Variation in shortleaf pine from several geographic sources. For. Sci. 16: 415-423.

Wells, O. O., P. E. Barnett, H. J. Derr, D. T. Funk, T. LaFarge, E. R. Lawson, and S. Little.
1978. Performance of shortleaf x slash pine hybrids in parts of the Southeastern United States. South. J. Appl. For. 2: 28-32.

Acknowledgment: The experiment was designed by P. C. Wakeley, now retired, Southern Forest Experiment Station.

U.S. GOVERNMENT PRINTING OFFICE:—1978-772-032